

P5 Plan

Hitoshi Murayama
Town Hall at LBNL, Feb 22, 2023



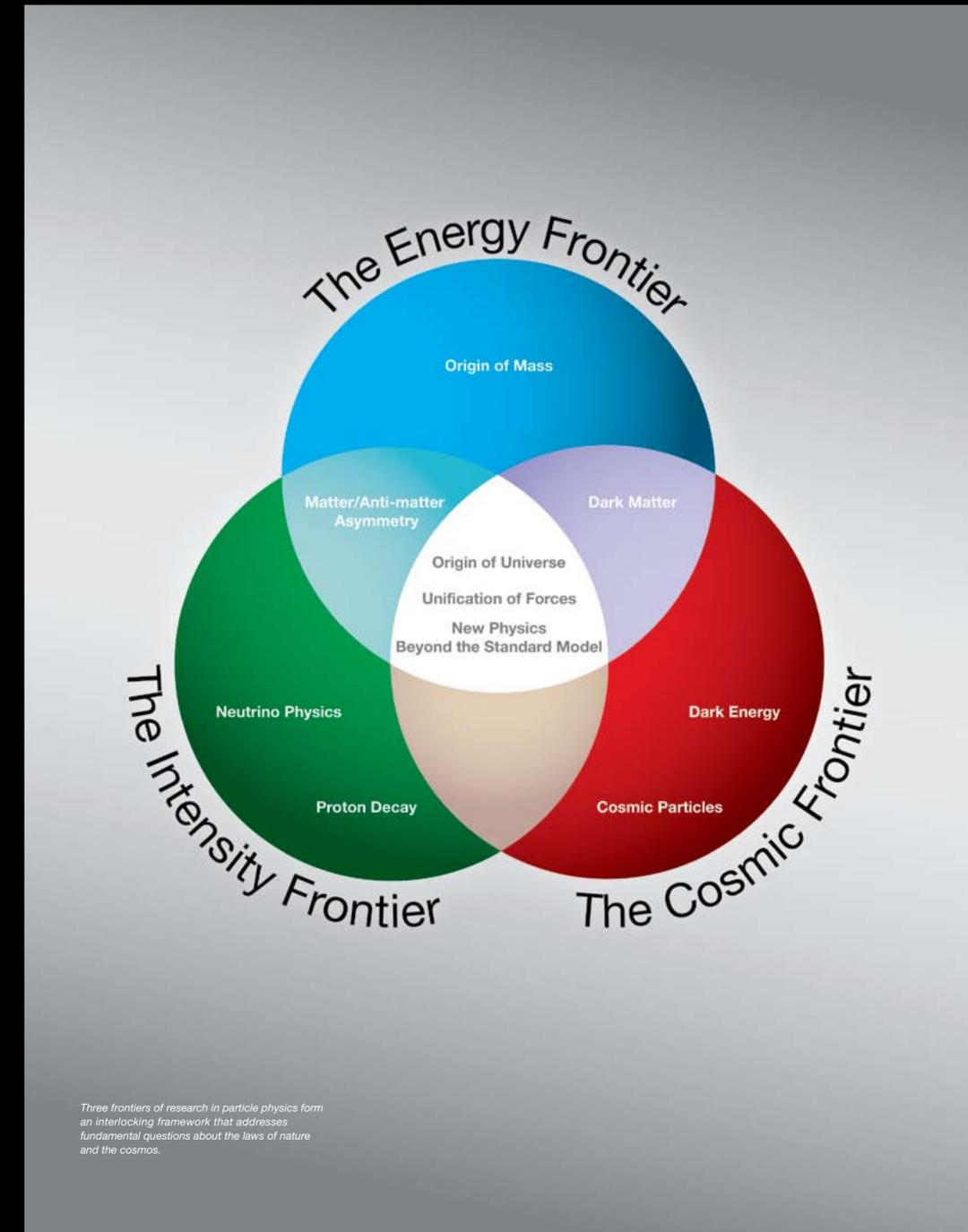
Key Elements of a Successful P5

- Well informed by the science community
- Set a grand long-range vision for U.S. particle physics
- Faced budget constraints realistically
 - “Community made tough choices.”
- **Balanced portfolio**
 - Domestic and international
 - Small, mid-scale, and large projects
- **Community engagement critical to success**
 - “Bickering scientists get nothing.”

Harriet Kung, Snowmass in Seattle

2008 P5

- 2008 P5 (Charlie Baltay)
 - First “modern” P5 with budget scenarios and long-term vision
 - Energy, Intensity, Cosmic Frontiers
 - Tevatron for one to two more years
 - **World-class neutrino program**
 - **Dark matter & dark energy, LSST**
- *US Particle Physics: Scientific Opportunities A Strategic Plan for the Next Ten Years*



2014 P5

- 2014 P5 (Steve Ritz)
 - Use the Higgs boson as a new tool for discovery
 - Pursue the physics associated with neutrino mass
 - Identify the new physics of dark matter
 - Understand cosmic acceleration: dark energy and inflation
 - Explore the unknown: new particles, interactions, and physical principles.
- Finally “got it right”
 - Well received in Washington
 - **Embraced CMB (inflation)**
- *Building for Discovery*

Buil
Strategic

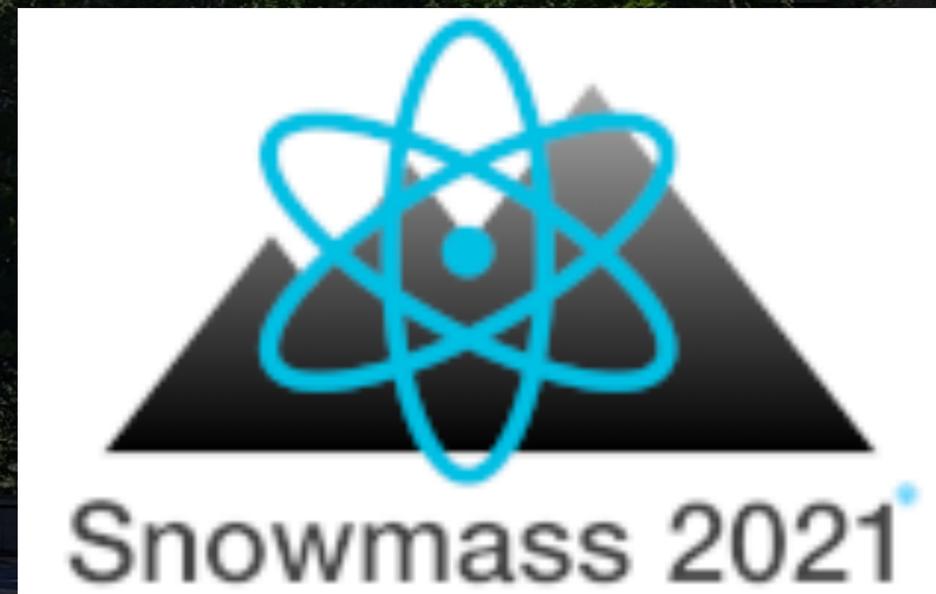
Figure 1
Construction and Physics Timeline



FIGURE 1 Approximate construction (blue; above line) and expected physics (green; below line) profiles for the recommended major projects, grouped by size (Large [$>$ \$200M] in the upper section, Medium and Small [$<$ \$200M] in the lower section), shown for Scenario B. The LHC: Phase 1 upgrade is a Medium project, but shown next to the HL-LHC for context. The figure does not show the suite of small experiments that will be built and produce new results regularly.

My take away from Snowmass

- We have an exciting program lined up
 - Thanks to Steve Ritz, previous P5, agencies!
- We are broader than the current program energy, intensity, cosmic
 - Where is the boundary of our field?
- We are a forward-looking community
 - We need program beyond what the previous P5 outlined
 - We also need more freedom
 - better balance big, medium, small; projects vs research
- We deeply care about our community
 - Diversity, equity, inclusion, outreach, engagement
- Visited both DOE & NSF in early September
 - I'm still scared of the tasks ahead.
 - Reading Snowmass reports!



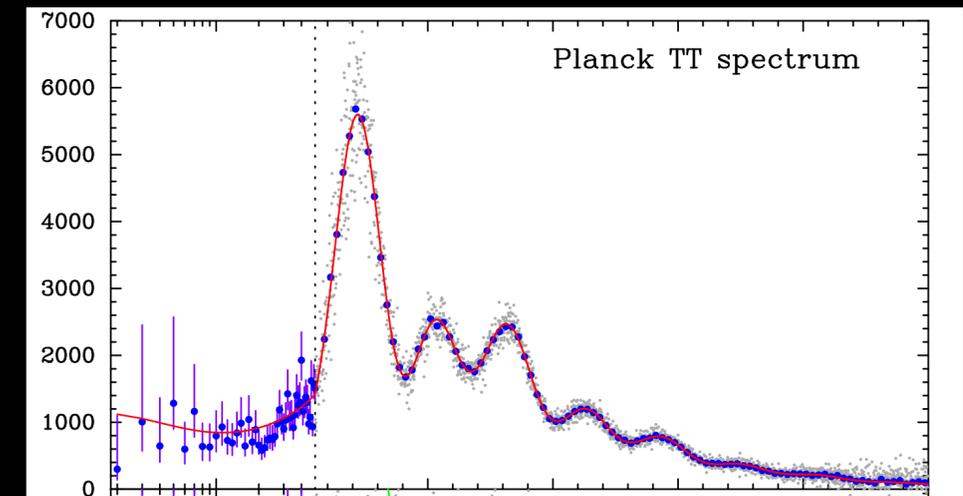
Last P5 science drivers

- Use the **Higgs boson** as a new tool for discovery
- Pursue the physics associated with **neutrino** mass
- Identify the new physics of **dark matter**
- Understand cosmic acceleration: **dark energy** and **inflation**
- Explore the **unknown**: new particles, interactions, and physical principles.
- Still very much true
- Main aim: physics beyond the standard model



Five evidences for physics beyond SM

- at least five missing pieces in the SM
 - dark matter
 - neutrino mass
 - dark energy
 - apparently acausal density fluctuations
 - baryon asymmetry



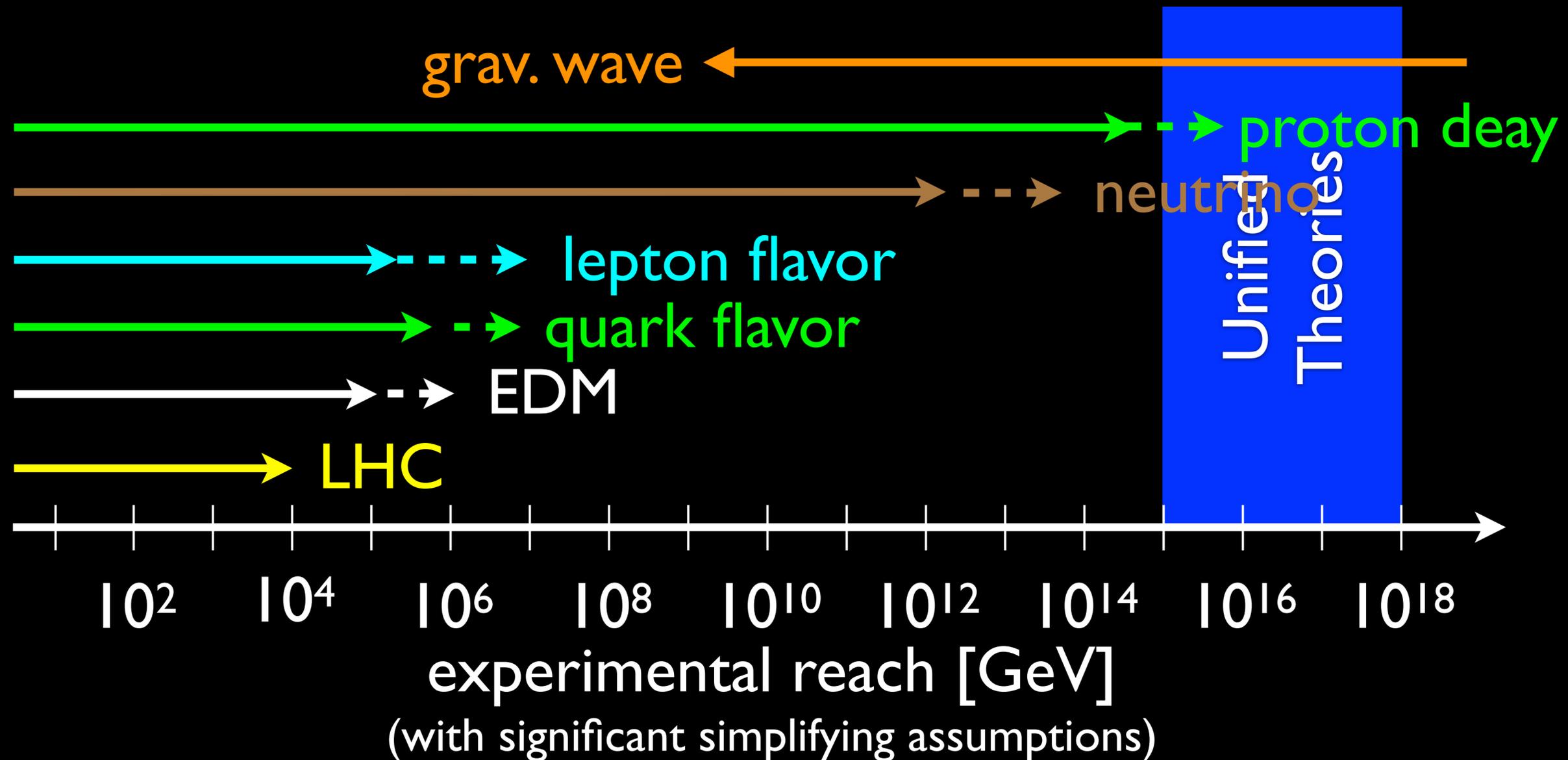
Unusual in science: the problems are clear!

- theoretical problems:
 - hierarchy problem
 - origin of flavor
 - unification of matter and forces
 - quantum gravity

also anomalies (H_0 , σ_8 , flavor, $g-2$)

Where is the next energy scale?

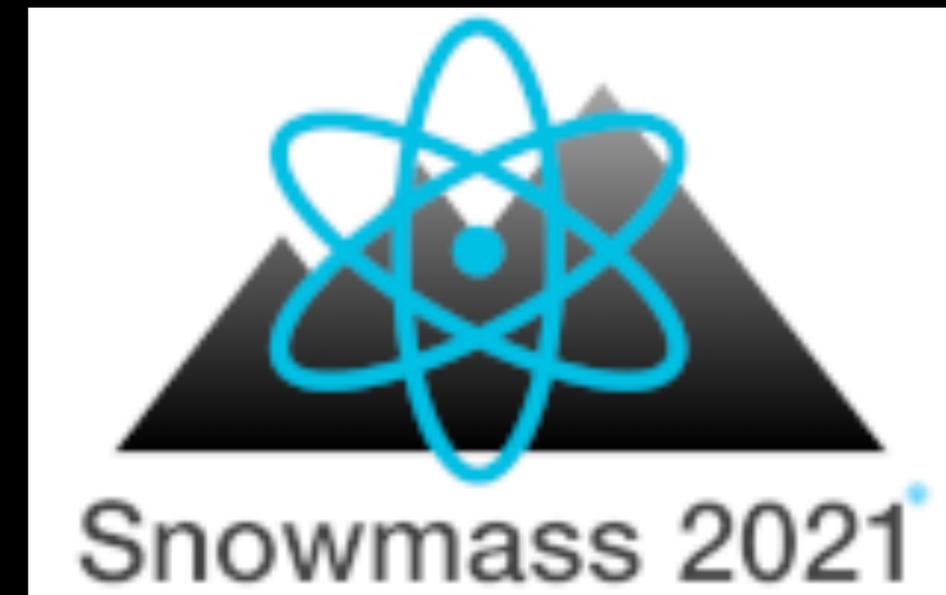
Power of Expedition



w/ Zoltan Ligeti for 2008 P5 (Baltay panel)

Changing landscape

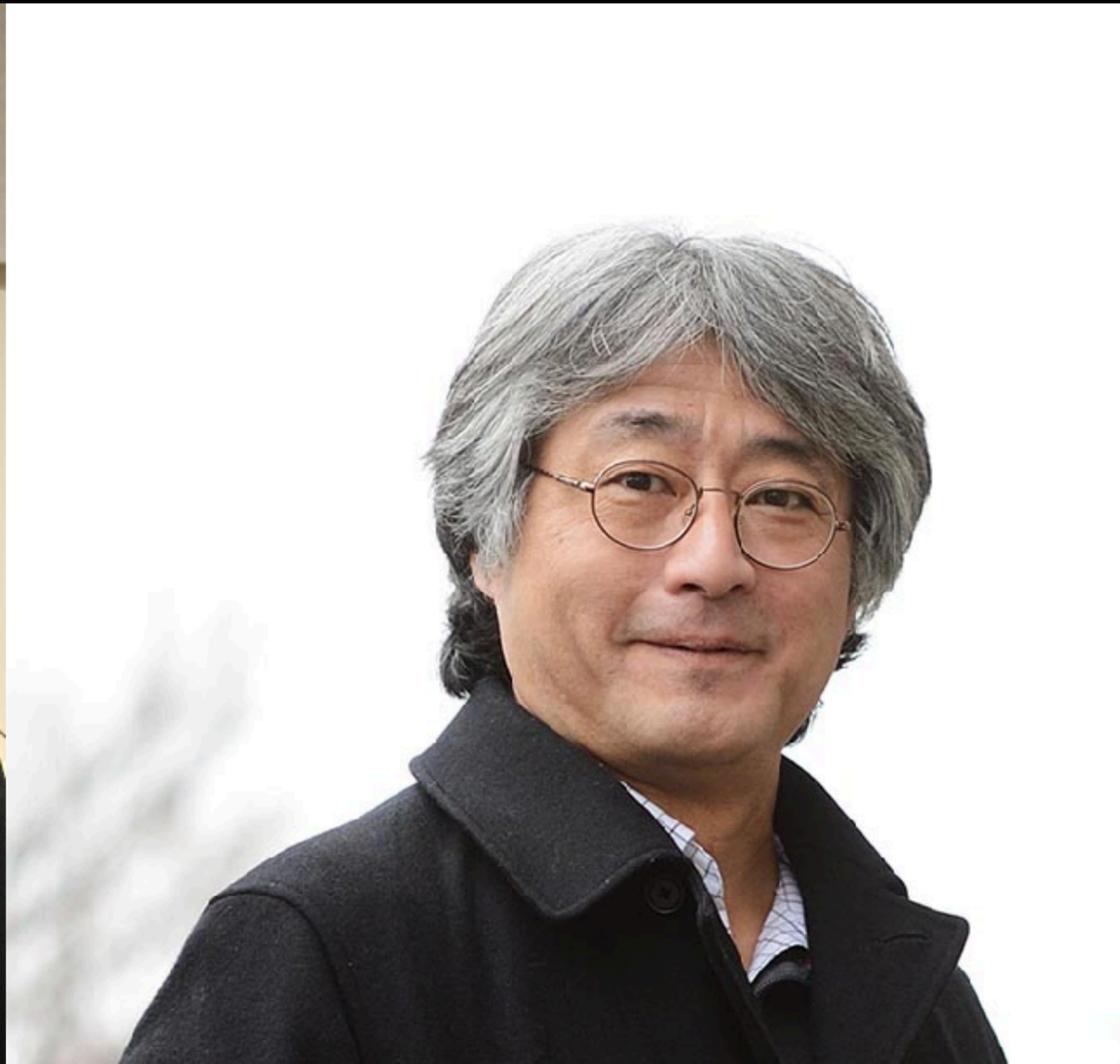
- 125 GeV Higgs does look like standard model
 - Previous P5: “Higgs as a new tool for discovery”
- Recognition that dark matter parameter space is *big*
 - Growing in interest in low-energy weakly coupled sector
- Λ CDM + inflation is the new Standard Model
 - But H_0 , σ_8 tension
 - Inflation, cosmological constant vs swampland?
- DUNE moving ahead
 - Now Hyper-Kamiokande is also happening
- Lattice vs $g-2$?
- Interesting anomalies in flavor physics
- Gravitational wave! High-energy neutrinos!
- Now 10 frontiers (+costing frontier?)
- National Initiatives: Quantum, AI/ML, microelectronics
- Field is more global than ever, yet geopolitical challenges, climate change



Leadership team



JoAnne Hewett
HEPAP chair



Karsten Heeger



I already see it is a great panel!

Decadal Overview of Future Large-Scale Projects		
Frontier/Decade	How do we develop enabling technology for long-term vision in a fashion executable in 20 years?	
Energy Frontier	U.S. Initiative for the Targeted Development of Future Colliders and their Detectors	
	US role?	Higgs Factory Scope? Technology? Complementarity?
Neutrino Frontier	LBNF/DUNE Phase I & PIP- II	DUNE Phase II (incl. proton injector)
Cosmic Frontier	Cosmic Microwave Background - S4	Next Gen. Grav. Wave Observatory*
	Spectroscopic Survey - S5* Scope?	Line Intensity Mapping* Do we embrace them?
	Big, small, new? Multi-Scale Dark Matter Program (incl. Gen-3 WIMP searches)	
Rare Process Frontier		Advanced Muon Facility Scope? Other science?

Table 1-1. An overview, binned by decade, of future large-scale projects or programs (total projected costs of \$500M or larger) endorsed by one or more of the Snowmass Frontiers to address the essential scientific goals of the next two decades. This table is not a timeline, rather large projects are listed by the decade in which the preponderance of their activity is projected to occur. Projects may start sooner than indicated or may take longer to complete, as described in the frontier reports. Projects were not prioritized, nor examined in the context of budgetary scenarios. In the observational Cosmic program, project funding may come from sources other than HEP, as denoted by an asterisk.

Medium & small

- axion, emerging dark matter experiments
- IceCube Gen2, AugerPrime, CTA, Southern Wide-field Gamma Ray Observatory
- New detectors @ LHC: Faser ν , MATHUSLA, CODEX-b, FACET
- dark sector beam dump
- Short-baseline ν , ν cross sections, astrophysical ν
- Hadrons, lepton flavor violation & non-universality, i.e. Mu2e-II
- Galaxy surveys beyond dark energy?
- CMB beyond inflation? (i.e. N_{eff})
- Gravitational wave?
- Line Intensity Mapping? (i.e. high- z 21cm)
- Cosmic ν background? $0\nu\beta\beta$ with DUNE far detector?

Balance

- Project vs research
- Large (>\$200M), medium (\$50-200M), small (<\$50M) (previous P5)
 - Collection of small may be medium
- Science vs R&D
 - Instrumentation, computing, theory
- National initiatives
 - AI/ML, microelectronics, QIS
 - How do we capitalize on it? How do we contribute to justify it?
- DEI
 - What can agencies do?
 - Example: blind reviews for Hubble Space Telescope (not for us)

Interface to EPP2024



- EPP2024 looks into long-term vision, dreams
 - unconstrained by budget scenarios
- I was on EPP2024 until I was appointed as the P5 chair
- JoAnne and I participated in their November & December meetings
- We invite all EPP2024 members to P5 town halls to make sure we get the same inputs from the community
 - We will overlap at Fermilab in March
- Will keep informing EPP2024 about our progress and vice versa
- Hopefully what we recommend will smoothly connect to their longer-term vision

Costs

- One lesson from the previous P5 was some of the costs were off by a factor of $\sim\pi$
- Need to understand maturity of cost estimates better
- We are putting together another expert panel to look into costs, risks, schedule
- Chair: Jay Marx (STAR, LIGO)
- That panel will ask for inputs from collaborations in March
- We will receive their assessment by May



Jay Marx

Community interest

- >440 participants!
- Including 157 in-person registrants
- Short remarks oversubscribed x3
- 24 accepted
- Sorry for rejected ones
- Please try again at later town halls!

P5 Town Hall at LBNL
Lawrence Berkeley National Laboratory

22-24 Feb 2023

Overview | Timetable | Registration | Required Full Registration for On-Site Participants | Speaker List | Code of Conduct | Contribution List | My Conference | My Contributions | Call for Remarks in the Open Session | Accommodations | Transportation | Site Access | Day Care | Accessibility | COVID precautions | Participant List | Committees | Future P5 Town Hall meetings | P5 Main Page

Timetable

Wed 22/02 | Thu 23/02 | Fri 24/02 | All days

Print PDF Full screen Detailed view Filter Session legend

Coffee Coffee Dark Energy Dark Matter

07:00

Morning Refreshments

08:00

850 Auditorium, Lawrence Berkeley National Laboratory 07:45 - 08:25

Logistics Anthony Spalato

850 Auditorium, Lawrence Berkeley National Laboratory 08:30 - 08:35

PS process Hiroshi Murayama

850 Auditorium, Lawrence Berkeley National Laboratory 08:35 - 08:55

Welcome to LBNL Mike Wilczek

850 Auditorium, Lawrence Berkeley National Laboratory 08:55 - 09:00

Future P5 Town Hall meetings Fran Hanson

850 Auditorium, Lawrence Berkeley National Laboratory 09:00 - 09:20

P5 2024 Maria Sperguta et al.

850 Auditorium, Lawrence Berkeley National Laboratory 09:20 - 09:40

Overview including Astrophysical probes Mariangela Lisani

850 Auditorium, Lawrence Berkeley National Laboratory 09:40 - 10:05

noble gas-based direct detection & G3 Dan Akkerh

850 Auditorium, Lawrence Berkeley National Laboratory 10:05 - 10:35

Coffee

850 Auditorium, Lawrence Berkeley National Laboratory 10:35 - 11:05

Solid state based direct detection & G3 Matt Pyle

850 Auditorium, Lawrence Berkeley National Laboratory 11:05 - 11:35

Axon direct detection (haloscope & helioscope) & G3 Gary Ryba

850 Auditorium, Lawrence Berkeley National Laboratory 11:35 - 12:05

Emerging concepts Tongyan Lin

850 Auditorium, Lawrence Berkeley National Laboratory 12:05 - 12:25

Group Photo

at the entrance of Building 50 12:25 - 12:35

Lunch

13:00

Building 15, Room 253 12:35 - 13:45

Overview Elizabeth Wilson

850 Auditorium, Lawrence Berkeley National Laboratory 13:45 - 14:15

Rollin and extension Chris Stubbs

850 Auditorium, Lawrence Berkeley National Laboratory 14:15 - 14:45

DESI - DESI-B Kyle Dawson

850 Auditorium, Lawrence Berkeley National Laboratory 14:45 - 15:05

Stage IV David Schlegel

850 Auditorium, Lawrence Berkeley National Laboratory 15:05 - 15:30

Coffee

850 Auditorium, Lawrence Berkeley National Laboratory 15:30 - 16:00

AIML Ben Nachman

850 Auditorium, Lawrence Berkeley National Laboratory 16:00 - 16:15

QIS Maurice Garcia-Schewes

850 Auditorium, Lawrence Berkeley National Laboratory 16:15 - 16:30

microelectronics Angelo Dragone

850 Auditorium, Lawrence Berkeley National Laboratory 16:30 - 16:45

DEI Rubin Ertvaer

850 Auditorium, Lawrence Berkeley National Laboratory 16:45 - 17:05

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Timetable

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Print PDF Full screen Detailed view Filter Session legend

5000 Eyes - DESI CMB CMB Coffee

07:00

Morning Refreshments

08:00

850 Auditorium, Lawrence Berkeley National Laboratory 07:45 - 08:30

Snowmass Cosmic Frontier Tan Tai

850 Auditorium, Lawrence Berkeley National Laboratory 08:30 - 09:00

APPEC (room) Andrew Haungs

850 Auditorium, Lawrence Berkeley National Laboratory 09:00 - 09:20

Overview (room) Dan Green

850 Auditorium, Lawrence Berkeley National Laboratory 09:20 - 09:45

Snowmass Observatory Andrew Lee

850 Auditorium, Lawrence Berkeley National Laboratory 09:45 - 09:55

SPT + BICEP Brad Benson

850 Auditorium, Lawrence Berkeley National Laboratory 09:55 - 10:15

Coffee

850 Auditorium, Lawrence Berkeley National Laboratory 10:10 - 10:40

CMB-S4 Jeff McMahon et al.

850 Auditorium, Lawrence Berkeley National Laboratory 10:40 - 11:15

Space Missions Masashi Hazumi

850 Auditorium, Lawrence Berkeley National Laboratory 11:15 - 11:30

Commercial Lunar Payload Services (room) Ache D'Souza

850 Auditorium, Lawrence Berkeley National Laboratory 11:55 - 12:10

Lunch

13:00

850 Auditorium, Lawrence Berkeley National Laboratory 12:30 - 13:45

LBNL Program Cameron Gades Nathan Palanca-Delebru

850 Auditorium, Lawrence Berkeley National Laboratory 13:40 - 14:00

(room) Cosmic Probes of Dark Matter Physics Alex Datta-Wagner et al.

850 Auditorium, Lawrence Berkeley National Laboratory 14:00 - 14:05

Science from high density galaxy samples with DESI-B Dr Evan Hubbleweil

850 Auditorium, Lawrence Berkeley National Laboratory 14:05 - 14:15

(room) Training the Next Generation of Physicists and Engineers at Universities Gregory Tarlé

850 Auditorium, Lawrence Berkeley National Laboratory 14:10 - 14:15

(room) Synergies of Survey Programs for Cosmic Frontier Dr Martin Rau

850 Auditorium, Lawrence Berkeley National Laboratory 14:15 - 14:25

Going Green: A Renewable Energy Future for High Energy Physics at the South Pole Jody Darden

850 Auditorium, Lawrence Berkeley National Laboratory 14:20 - 14:25

(room) Fifteen years of fruitful collaboration between French and DOE labs in cosmology Mr Christophe Vénier

850 Auditorium, Lawrence Berkeley National Laboratory 14:25 - 14:30

Leveraging Microelectronics through Dedicated Support for Implementation in HEP Experiments Javier Fidalgo

850 Auditorium, Lawrence Berkeley National Laboratory 14:30 - 14:35

(room) Continued support for funding small-scale experiments Yonatan Kahn

850 Auditorium, Lawrence Berkeley National Laboratory 14:35 - 14:45

Artificial Intelligence as a Core Component of the Cosmology Research Dr Aleksandra Czaplewski

850 Auditorium, Lawrence Berkeley National Laboratory 14:40 - 14:45

(room) Research Funding in Cosmic Frontier and throughout HEP Hugh Lapointe et al.

850 Auditorium, Lawrence Berkeley National Laboratory 14:45 - 14:50

Leveraging cross collaborations to detect new physics Dr Joseph D'Elia et al.

850 Auditorium, Lawrence Berkeley National Laboratory 14:50 - 14:55

(room) Dark Matter in the Local Universe With DESI-B and KiDS Constantine Sifonidis

850 Auditorium, Lawrence Berkeley National Laboratory 14:55 - 15:00

(room) Support for sensor detector technology R&D to expand the reach of existing experiments Anu Wang

850 Auditorium, Lawrence Berkeley National Laboratory 15:00 - 15:05

Reflections on DESI construction from early career scientists Claire Poppett

850 Auditorium, Lawrence Berkeley National Laboratory 15:05 - 15:10

(room) Foster the Development Necessary for the Next Generation of Flagship Projects Dr Katie Harrington

850 Auditorium, Lawrence Berkeley National Laboratory 15:10 - 15:15

Coffee Break

850 Auditorium, Lawrence Berkeley National Laboratory 15:15 - 15:45

(room) Seeing the Universe in 3-d Prof. David Eisenstein

850 Auditorium, Lawrence Berkeley National Laboratory 15:45 - 15:50

(room) Survey synergies: direct calibration of weak lensing surveys with spectroscopy Noah Benitez

850 Auditorium, Lawrence Berkeley National Laboratory 15:55 - 16:00

(room) DESI: A Successful University - National Laboratory Partnership Prof. Klaus Honscheid et al.

850 Auditorium, Lawrence Berkeley National Laboratory 16:00 - 16:05

Energy between cosmological research and the FCC program The US FCC collaboration

850 Auditorium, Lawrence Berkeley National Laboratory 16:05 - 16:15

(room) The Need for R&D Towards a Stage 5 CMB Facility Prof. Neelke Dirlikov

850 Auditorium, Lawrence Berkeley National Laboratory 16:10 - 16:15

(room) Multi-TeV colliders based on advanced accelerator concepts for the Energy Frontier Dr Leonardo Otte Hübner

850 Auditorium, Lawrence Berkeley National Laboratory 16:15 - 16:20

Joint Modelling of Astrophysical Systematics for Cosmology with LSST Mr. Niko Savanis et al.

850 Auditorium, Lawrence Berkeley National Laboratory 16:20 - 16:25

(room) Significance of Simulation Capability Readiness for the Next Era of Cosmic Frontier Science Dr Nicholas Frontoni

850 Auditorium, Lawrence Berkeley National Laboratory 16:25 - 16:30

Open-Mike Session

850 Auditorium, Lawrence Berkeley National Laboratory 16:30 - 17:00

Reception

17:00

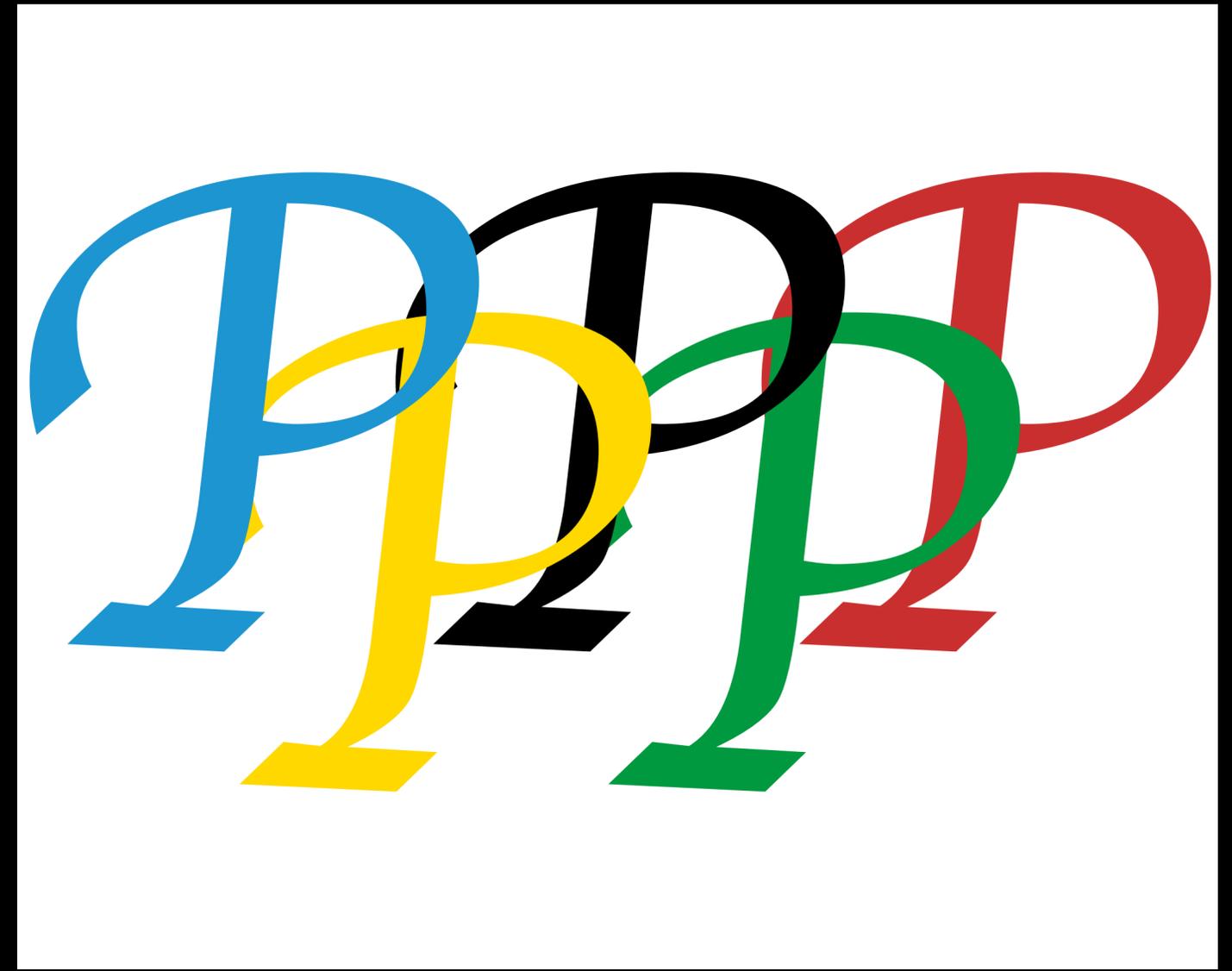
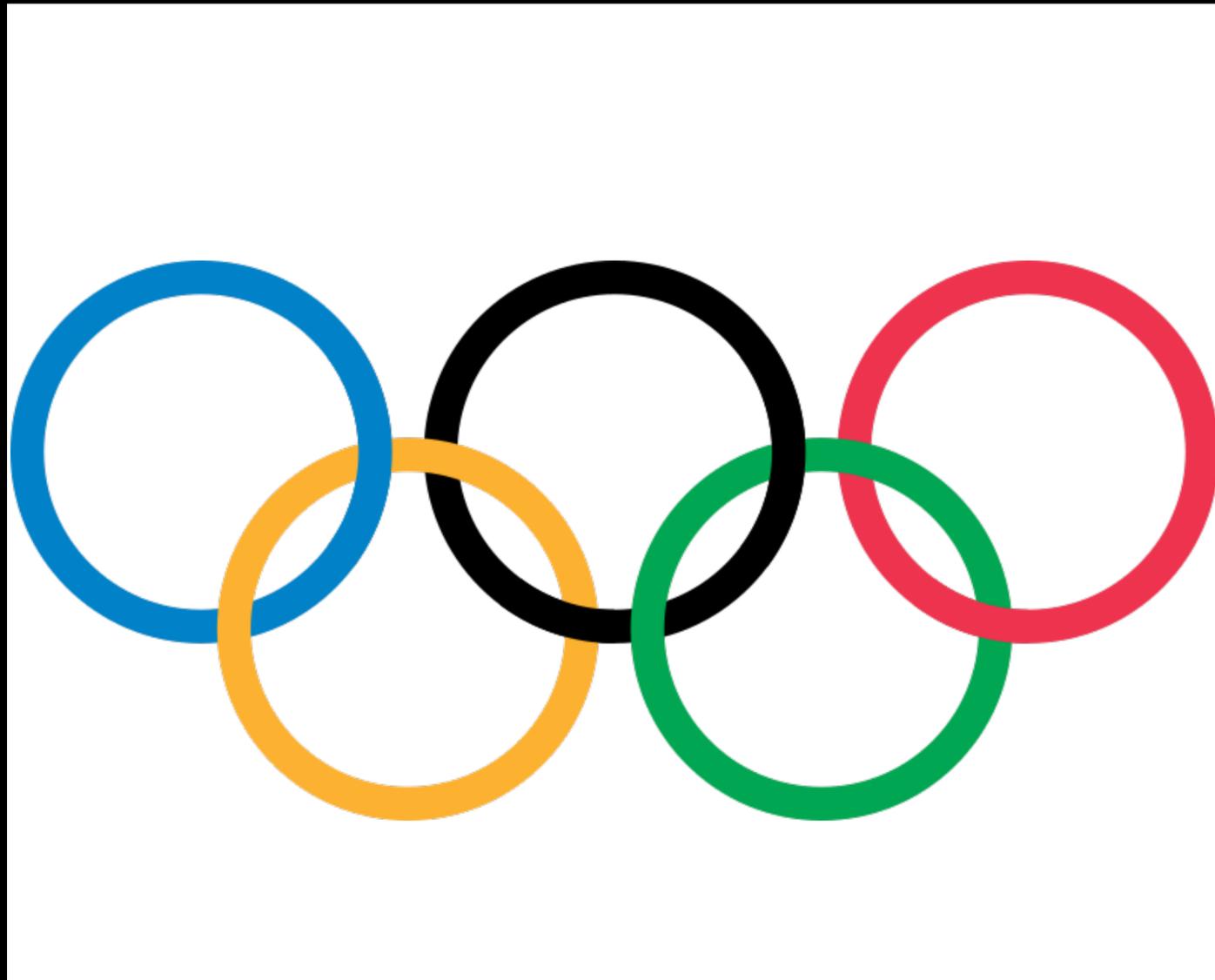
Wang Hall, Building 50 17:00 - 18:00

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Coming meetings

- Open Town Halls
 - LBNL: today and tomorrow.
 - Fermilab/Argonne: March 21, 22, 23
 - Brookhaven: April 12, 13, 14 (just before DPF in Minnesota)
 - SLAC: May 3, 4, 5
 - Sign up for making short remarks! (This time x3 oversubscription)
- DPF session on P5 (April 15?)
- Jay Marx committee running in parallel
- Virtual Town Halls
- Closed meetings
- Preliminary recommendations August
- Final report due October

P5 tentative logo



Apologies to Antarctica! CMB and IceCube

Survey on the LBNL Town Hall

* 1. Have you attended the town hall in-person or remote?

- in-person
- remote

2. Was the ASL interpretation useful to you?

- Yes
- No

Please comment on the quality of the interpretation.

3. Was the live captioning useful for you?

- Yes
- No

Please comment on the quality of the captioning.

4. Any issues with physical access?

- Yes
- No

If any, please describe the problems you encountered.

5. Did you have problems reading the slides?

- Yes
- Sometimes
- No

Please describe the nature of the problems, e.g., choice of colors, size of fonts, speed of network

6. Was the link to day care centers useful for you?

- Yes
- No

7. How useful was the Town Hall overall?

- Extremely useful
- Very useful
- Somewhat useful
- Not so useful
- Not at all useful

Add any comments you may have about the Town Hall

Done

I ask you to fill out the survey on Thursday
<https://www.surveymonkey.com/r/5WZ5785>

Maximize science!

